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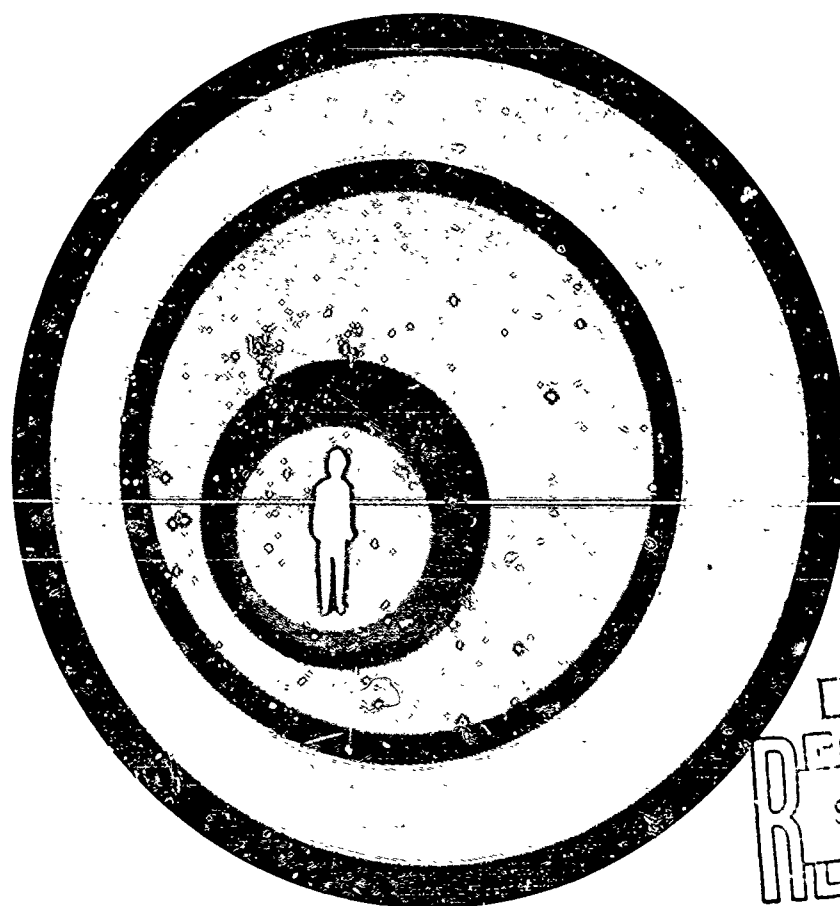
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TRAINING  
ANALYSIS  
AND  
EVALUATION  
GROUP

TECHNICAL MEMORANDUM 76-1

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## TRAINING RESOURCE CLASSIFICATIONS: DIRECT-INDIRECT AND FIXED-VARIABLE COST CATEGORIES



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↙ The four resource cost categories of direct, indirect, fixed, and variable cause the greatest misunderstanding. This memorandum discusses the difficulties encountered when using these classification schemes and offers a set of definitions which attempts to remove the ambiguities associated with their use.

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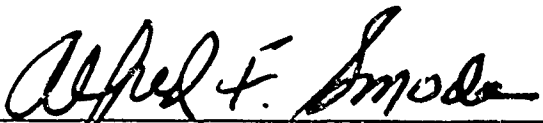
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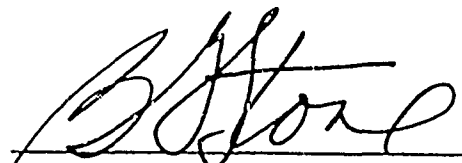
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TRAINING RESOURCE CLASSIFICATIONS:  
DIRECT-INDIRECT AND FIXED-VARIABLE COST CATEGORIES

SECTION I

INTRODUCTION

BACKGROUND

The primary mission of the Chief of Naval Education and Training (CNET) is to provide adequately trained personnel to the Operational Commands of the Navy. To accomplish this mission CNET functions as a service organization which must respond to the changing training needs of the Navy. CNET has responsibility for the management of some of the resources which are committed to fulfill the training mission. Therefore, to plan and execute an efficient training system CNET must receive timely and consistent information. This need for information has stimulated, within the command, a number of efforts to identify and develop management information. Currently, high level managers are using such gross indices of effectiveness and efficiency as student-to-staff ratios and cost per student graduate. But these indices are meaningful to managers only if they give a clear understanding of the factors included in each index and if the computational procedures are consistent from period to period. Too often the available information is inconsistent, sketchy, and ambiguous.

Information required by managers must, in addition to providing measures of efficiency and effectiveness, be classified by resource use. Information derived from classified resources is used to determine the effect the implementation or termination of a given training system or unit of instruction will have on cost and to determine the effect a change in output will have on cost. The utility of any classification scheme depends on how well it meets these management needs.

PURPOSE

On 10 and 11 February 1976, CNET sponsored a workshop to discuss the development of CNET management indices. The workshop participants recognized that ambiguity exists in the definitions used to classify training resources. In an effort to bring into focus these deficiencies, the Training Analysis and Evaluation Group (TAEG) was tasked to "...investigate the adequacy of current definitions of direct and indirect support (costs). In particular, this investigation should determine the extent to which fixed and variable training resources are sensitive to lead times. The dependence of direct and indirect support definitions on the fixed or variable character of resources should be clearly delineated" (Ref. 1).

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Some controversy, misunderstanding, and ambiguities have arisen from the existing resource classifications. Direct, indirect, fixed and variable are four resource cost categories which have caused the largest share of misunderstanding. This memorandum discusses the difficulties encountered when using these classification schemes and offers a set of definitions which attempts to remove the ambiguities associated with their use.

## SECTION II

### DISCUSSION

#### OVERVIEW

The concept of fixed and variable costs has a precise meaning in economics and can be applied to management decisions without ambiguity. Two distinct points must be considered when discussing fixed and variable costs. First, these concepts have traditionally, in the economic literature, been associated with the analysis of costs as these costs respond to changes in output levels. Second, the level of both fixed and variable costs are time dependent. The time dimension, referred to as either the "short-run" or the "long-run," is a relative time comparison. In the short-run there are resources which cannot be varied, and in the long-run it is assumed that all resources are variable. The analytical tools for short-run analyses differ markedly from those used in long-run analyses. Short-run analyses deal primarily with operational problems which must be resolved within a limited and specified time period, while long-run analyses are relevant to planning problems which may have effects extending over many years.

The concepts of direct and indirect costs, unlike fixed and variable costs, lack theoretical underpinnings and have evolved out of a perceived need to identify and separate those costs which are uniquely related to a type of activity. The difficulty with the direct-indirect classification concept is that the basic definitions which have evolved lack uniformity and consistency. Thus, the application of the concepts by different users frequently leads to ambiguities.

The remainder of this section is devoted to a discussion of fixed-variable costs, direct-indirect costs, and a comparison of the two classification schemes.

#### FIXED VS. VARIABLE COSTS

Fixed costs are defined as the costs of those resources which cannot be changed as output levels change over some specified period of time. For example, assume the director of a training program is required to double the throughput within the next six months. Within this relatively short time period new facilities cannot be planned and constructed, thus costs attributed to the use of existing facilities will remain unchanged, or fixed. The amount of fixed costs, and even what resources are considered fixed, depends upon the time available for adjustments. Given enough time, buildings, capital equipment and even the administrative overhead structure can be replaced with that which is most efficient in producing the new output levels. It is, therefore, meaningless to state or try to determine the amount of fixed costs in training without first making



explicit the time frame within which those determinations are to be made. It is equally fruitless to try to identify certain types of resources as fixed resources without reference to time and the circumstances involved.

Variable costs are defined as the costs of those resources which can be varied over a given time period to accommodate changes in output levels. In the above example, where output levels are to be doubled within six months, it will be possible to make adjustments in personnel, to vary the amount of expendable supplies used and to change the level of a number of other productive factors. As the time period is extended more costs become variable and with an indefinite time frame all costs become variable.

#### DIRECT VS. INDIRECT COSTS

Direct costs are the costs of resources whose use would be eliminated if, for a given level of output, a training capability was eliminated within a specified time period. This definition resembles the definitions of fixed and variable costs in that the magnitude of costs within both classes depends on a specified level of output and is constrained to a definite period of time. However, the concept of direct costs differs from the concept of fixed costs in that direct costs are defined for one specific output level only. Direct costs differ from variable costs in that direct costs can include costs which do not vary as output levels change. It is apparent that direct costs can include both fixed and variable costs.

Indirect costs are those costs associated with a course which will remain even if that course is eliminated. These costs are usually those involved in joint production and associated with the stock or capital assets.

The definitions of direct and indirect costs given above were developed by TAEG. The need for these definitions stems from ambiguities in the existing definitions and the lack of a common base from which to develop specific definitions. The difficulty with the application of any classification scheme is the quantification of costs stemming from the use of resources which are involved in joint production. The proposed definitions do not, nor will any definition, resolve this difficulty, but the definitions do provide a set of consistent ground rules which can be used to evaluate each specific situation.

It is noteworthy that most major reporting systems define the terms direct and indirect without considering other existing definitions. The Military Manpower Training Report (MMTR), for example, defines direct and indirect in terms of the sensitivity of the costs (either manpower

or money) to relatively small changes in training workload. In contrast, the Per Capita Cost to Train Report, which in turn is derived from data in the Resource Management System (RMS), defines direct in terms of the commonality of services and explicitly identifies indirect as the cost only of hospitals, of family housing services, and of aircraft carrier operations. OPNAVINST 1500.39, which promulgates a listing of education and training definitions, does not address the subject of direct and indirect costs.

It is apparent that the concepts of direct and indirect costs are not rigorously defined. The use of the terms is not consistent among reporting and data systems, and some of the definitions, obtained from various sources, appear to duplicate in many respects the definitions of fixed and variable costs. Various existing definitions of direct and indirect costs are presented in appendix A to illustrate this lack of uniformity.

Using the MMTR and cost-to-train system definitions of the direct-indirect cost relationships as two examples, the problems associated with existing definitions and their ambiguities become obvious. The MMTR defines direct student support as the "Manpower whose numbers are sensitive to relatively small changes (e.g., up to 15 percent) in total workload." This definition states that resource costs which vary with output levels are direct. The difficulty arises first, because the definition is contingent upon changes in output levels as is variable costs and, second, unlike the definition of variable costs the time limits are not specified. Even the number of instructors devoted to a particular course could be insensitive to a 15 percent change in throughput in the short-run. According to the MMTR definition the costs of these instructors would be considered indirect, even though the instructors devoted full-time to the course. In the long-run all resources are variable and could be adjusted to accommodate a 15 percent increase in the throughput of a course. Based on the MMTR definition, and depending on whether one takes the short-run or long-run view, there is a basis for arguing that the costs are either direct or indirect. The definition is, therefore, ambiguous.

In contrast to the MMTR, the cost-to-train system definition states, in part, that direct training costs are "those costs directly identifiable to a school or course." This definition does not relate direct costs to output levels as does the MMTR definitions, nor does it specify the time dimension under which the determinations are to be made. Since direct costs, according to this definition, are not a function of output levels, it does not appear to conflict with the definition of variable or fixed costs, and can include both concepts; i.e., direct costs can include costs which vary as well as those which do not vary with changes in output levels. The cost-to-train system explicitly identifies those costing areas which are indirect costs.

A further difficulty with the cost-to-train system is that it fully allocates both direct and indirect costs to a course. The costs involved in a management decision to alter the status quo can seldom be realistically estimated from fully allocating both the direct and indirect costs to individual courses. Indirect (or supportive) costs of operation which are, in fact, most often incurred jointly with other courses cannot be meaningfully separated. Moreover, it is seldom necessary to separate these costs to have good management information. Management needs to know the marginal or incremental costs to determine efficient courses of action, and this is not obtained by fully allocating all training costs. Hitch and McKean discuss the problem of fully allocating costs as follows:

If a formula for allocating total costs among uses is intended to show how costs respond when one use is eliminated, it can serve a very useful purpose; it is then an attempt to get better estimates of incremental costs. But a formula that is supposed to hand out "fair shares" of joint costs, the shares exactly exhausting the total, is not needed for good decisions and can lead to bad ones. Inability to allocate all costs meaningfully among joint products is often a fact of life, not a disgrace or a sign of laziness. The extra cost of adding on a function or a feature can be calculated, or the total cost of the combination of features-- but not a meaningful total cost for one feature when undertaken jointly with the others (Ref. 2).

Hitch and McKean imply that only when fully allocated costs show how costs respond to incremental changes are they very useful. This criterion for usefulness is more nearly met when fully allocated costs are used for long-range planning. When courses are eliminated there are many resources which can only be readjusted in the long-run, therefore, for short-run decisions it may not be possible to capture all the savings which have been estimated from fully allocated costs. It would appear that fully allocated costs are of value only to high level managers involved in long-run planning.

Because the resources involved in joint production are related to costs in a nonadditive way, it will usually be very difficult to separate and to allocate indirect costs to individual courses. Indirect costs can conceptually be reduced to zero if the time period is extended such that there is enough time to acquire (or eliminate) the capital assets which are most (least) efficient in producing the new output levels. As a practical matter the operational and planning horizons are usually so restricted that analysts will encounter indirect costs.

The following example illustrates how different resources may be classified as direct or as indirect depending upon circumstances involved. Assume that at a particular activity three courses are being taught,

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course A uses building 1 exclusively, courses B and C share building 2, and courses A and C share building 3. In the matrix below, the blocks checked indicate which building is used for which course and the annual maintenance costs for each building.

	<u>COURSE A</u>	<u>COURSE B</u>	<u>COURSE C</u>	<u>MAINTENANCE COSTS</u>
Building 1	X			\$1000
Building 2		X	X	2000
Building 3	X		X	<u>3000</u>
Total				\$6000

Should the manager be faced with a decision to eliminate one, or any combination of courses, the building released and the annual maintenance savings are as follows:

<u>COURSE(S) ELIMINATED</u>	<u>BUILDING NO. RELEASED</u>	<u>DIRECT COSTS SAVINGS</u>
A	1	\$1000
B	0	0
C	0	0
AB	1	1000
AC	1 & 3	4000
BC	2	2000
ABC	1,2,3	6000

It is apparent that direct cost savings depend on which course(s) is (are) eliminated and not on the resource to be released. If only course B (or C) were to be eliminated then all buildings would have to be maintained since they are necessary for the remaining courses. However, if both B and C courses were eliminated then building 2 could be released for a saving of \$2000. The elimination of all courses (A, B, and C) would allow all the buildings to be released and result in a savings of \$6000. It is implicitly assumed in this example that sufficient time is allowed for adjustment in the maintenance, hence the costs, associated with the use of the buildings.

## SUMMARY

Data systems which collect and separate costs into fixed-variable and direct-indirect must resolve the time issue if unambiguous aggregations

are to be made. Both classification schemes are feasible and useful but only when they deal with explicit and specified time periods and output levels. CNET will have to continue to provide information to data systems such as MMTR and Navy Resource Model (NARM) in the form requested, but it is obvious that the validity of such data will continue to be questionable because the definitions which dictate the way the data are to be collected are ambiguous and inconsistent. The following definitions are recommended for use within CNET. These definitions make explicit the time frame.

- . Direct Costs. Those costs associated with a given course or instructional program operating at current levels which would be totally eliminated within one year of the disestablishment of that course or program. A majority of the costs within Formal Training are direct costs since they are uniquely related to a specific course and can be readily adjusted.
- . Indirect Costs. Those costs associated with a given course or instructional program operating at current levels which could not be eliminated within one year of the disestablishment of that course or program. The cost of many of the Supportive Programs will be indirect costs since these programs relate to several courses or instructional programs and cannot be eliminated or changed within the specified time.
- . Fixed Costs. Those costs which cannot be varied within the time frame in which a change of output levels is to be accomplished. For all output levels these costs would remain unchanged.

Variable Costs. Those costs which can be varied within the time frame within which output levels are to be changed. As output (e.g., student throughput) changes, variable costs change.

Supplementary definitions which may be necessary for an understanding of the above are as follows:

- . Formal Training. Programs which produce, through Navy managed courses of instruction, persons qualified to perform in specific operational or staff billets.
- . Supportive Programs. Those areas of endeavor under CNET management which require the expenditure of CNET resources, yet do not produce trained persons.

### SECTION III

#### TECHNICAL DISCUSSION OF DIRECT-INDIRECT AND FIXED-VARIABLE COST CONCEPTS

Any cost which varies as output levels change is a direct cost. That is, the manager will not be forced to incur any additional costs if, in fact, he is not required to increase his output levels. Since variable costs are defined as those which change with output levels, then it follows that all variable costs are direct costs. Since all costs become variable costs in the long run, then, only in the long run do all costs become direct costs. This simply means that, given enough time for adjustments to the resource package, the most efficient set of resources can be selected and matched to the output levels.

The short-run relationship between cost and output levels is illustrated by figure 1. The cost curves presented in figure 1 are typical of those which would exist for a training system which must change output in a relatively short period of time. From these curves, it is apparent that Total Costs = Total Fixed Costs + Total Variable Costs ( $TC = TFC + TVC$ ).

Assume, for example, that a training system is producing the number of students equal to  $S_1$  and must, during the very next class, increase this output to  $S_2$ . The total costs for output level  $S_1$  are:

$$TCS_1 = OC_2 + OC_1$$

$$TCS_1 = OC_4$$

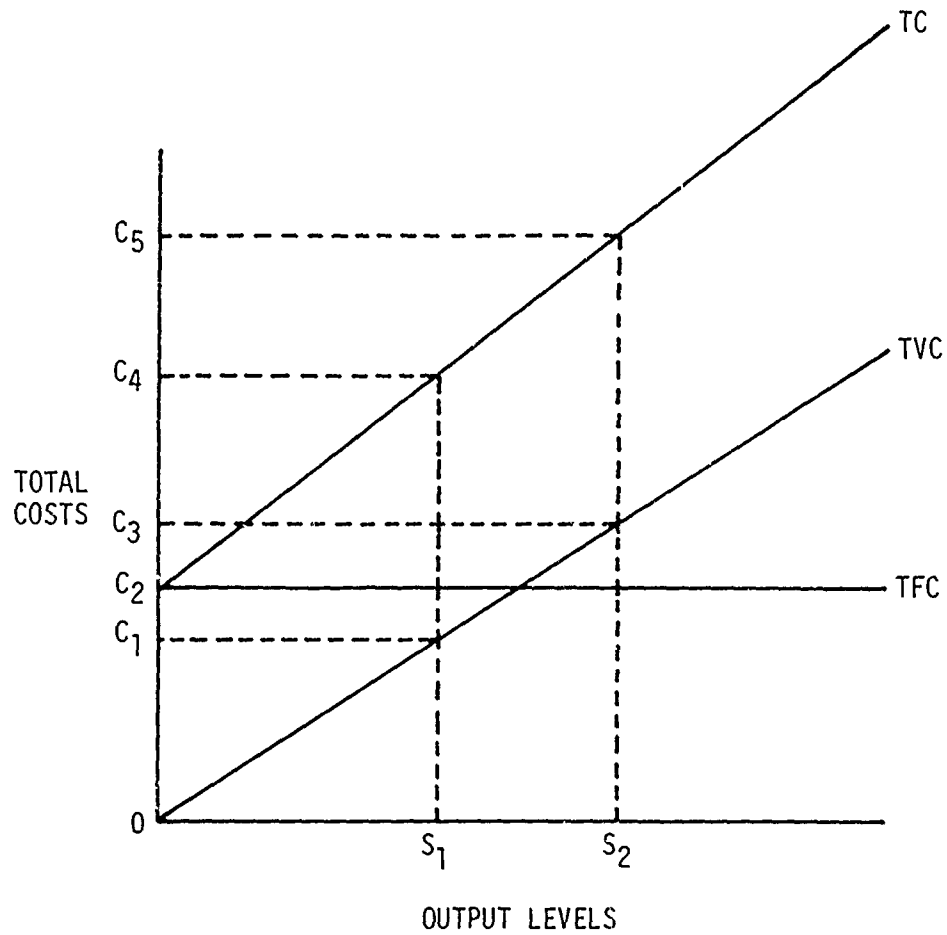
For the new output level  $S_2$  the fixed costs will not change since there will not be sufficient time to readjust these assets to "match" new output levels. These costs are:

$$TCS_2 = OC_2 + OC_3$$

$$TCS_2 = OC_5$$

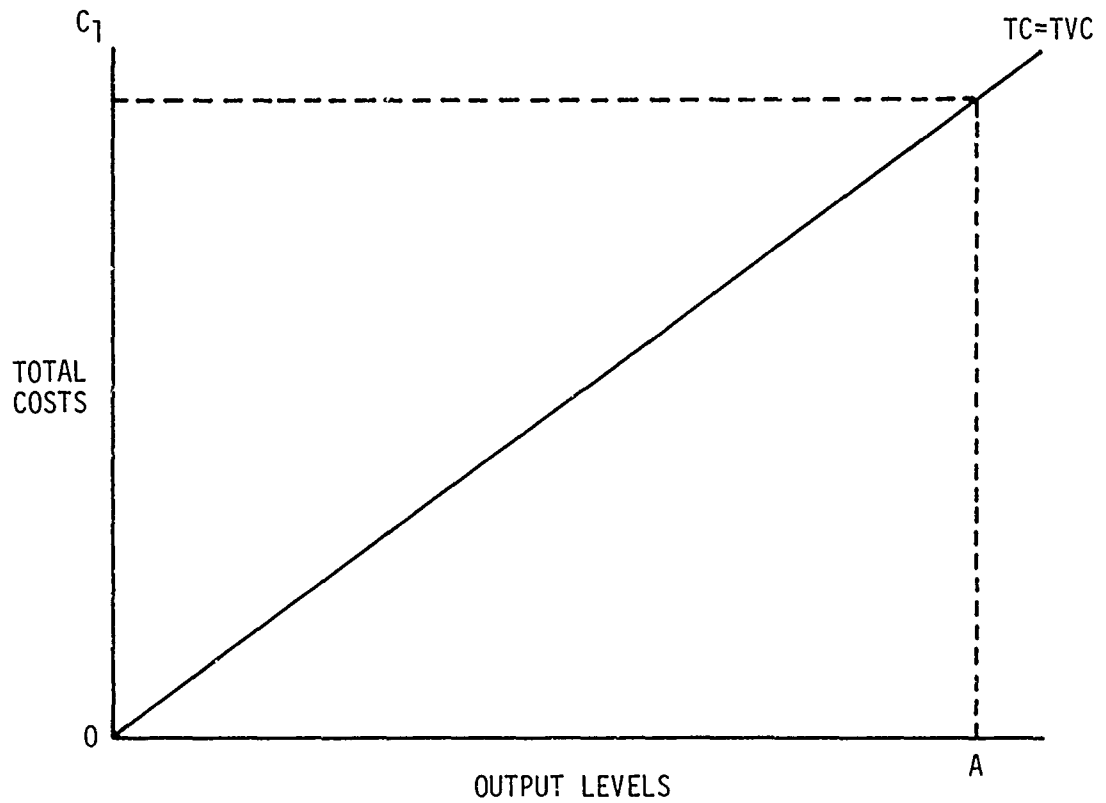
The variable resources represent the only assets which respond to changes in the output levels in the short-run.

The long-run relationship between cost and output level is illustrated by figure 2. The long-run is defined as a time period of sufficient length that all resources used in training can be adjusted (or varied) such that the most efficient set can be selected and used. As figure 2 illustrates, there are no fixed costs in the long-run.



$TC$  = TOTAL COSTS  
 $TVC$  = TOTAL VARIABLE COSTS  
 $TFC$  = TOTAL FIXED COSTS  
 $S$  = OUTPUT LEVEL  
 $C$  = INCREMENTAL COSTS

FIGURE 1. SHORT-RUN RELATIONSHIP BETWEEN  
TOTAL COSTS AND OUTPUT LEVELS



TC = TOTAL COSTS

TVC = TOTAL VARIABLE COSTS

A = OUTPUT LEVEL

C = COST LEVEL

FIGURE 2. LONG-RUN RELATIONSHIP BETWEEN TOTAL COSTS AND  
OUTPUT LEVELS



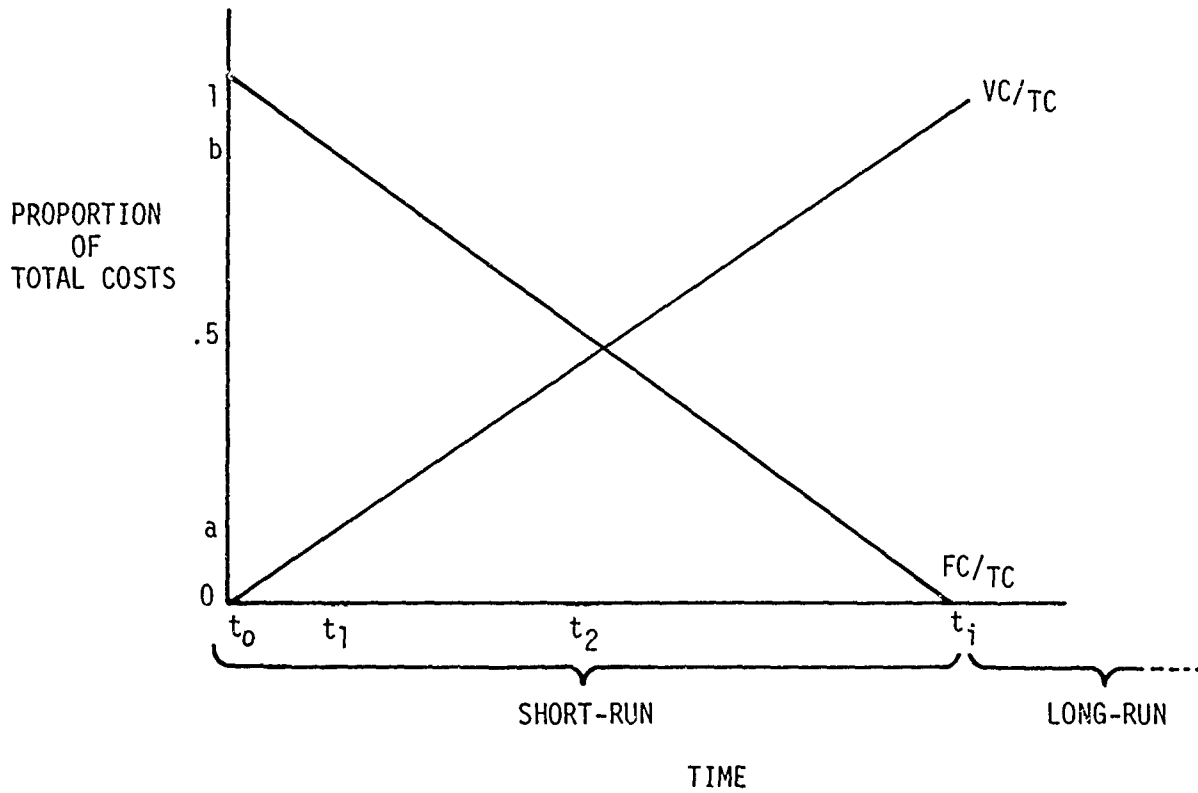
The operational manager who is required to adjust his resources in the short-run will be faced by cost curves which are similar to figure 1. The manager involved in long-range planning will be faced by a cost relationship which approximates that of figure 2.

The relationship between the ratios of fixed to variable costs and time is illustrated in figure 3. Management decisions requiring output which must be implemented in very short time periods will have a high proportion of the total resources in fixed assets. For example, when output must be increased within the time period  $t_0$ - $t_1$ , the proportion of total costs which are fixed would be  $ob$  and the remaining proportion, or variable costs, would be  $1-ob$  ( $oa$ ). However, if the output increases would be phased in over a time period equal to  $t_0$ - $t_2$ , then half of the resources can be varied and half are fixed. Given a time period equal to  $t_3$  all resources become variable and long-range plans can be developed and implemented which drive average training costs to a minimum.

Figure 4 illustrates the short-run total cost relationships between fixed-variable and direct-indirect. Since the relationships are short-run in nature, there are fixed costs involved. For an output level of  $OA$ , the total variable costs are illustrated by the shaded area  $C_2CE$  (which is equal to  $ODA$ ). The total fixed costs are illustrated by the hatched area  $OC_2CA$ .

All training costs which can be varied with changes in output levels will be eliminated if the training activity were eliminated. Therefore, all variable costs are direct costs and are so labeled on figure 4. There are also those costs which cannot be changed in the short-run in response to changes in the level of output. Those are the fixed costs in the hatched area in figure 4.

Costs which do not vary with output levels and which are devoted exclusively to a course under evaluation are fixed-direct costs. In figure 4 these costs are equal to  $C_1C_2CB$ . An example might be a library devoted exclusively to one course. These costs can be eliminated when the course is disestablished but cannot be eliminated in the very short-run or as long as the training capability is maintained. Costs which do not vary with output levels and are not devoted exclusively to a given course are fixed indirect costs. An example might be a library supporting several courses. In figure 4 these costs are equal to  $OC_1BA$ . These costs do not disappear in the short-run with the elimination of a single course.



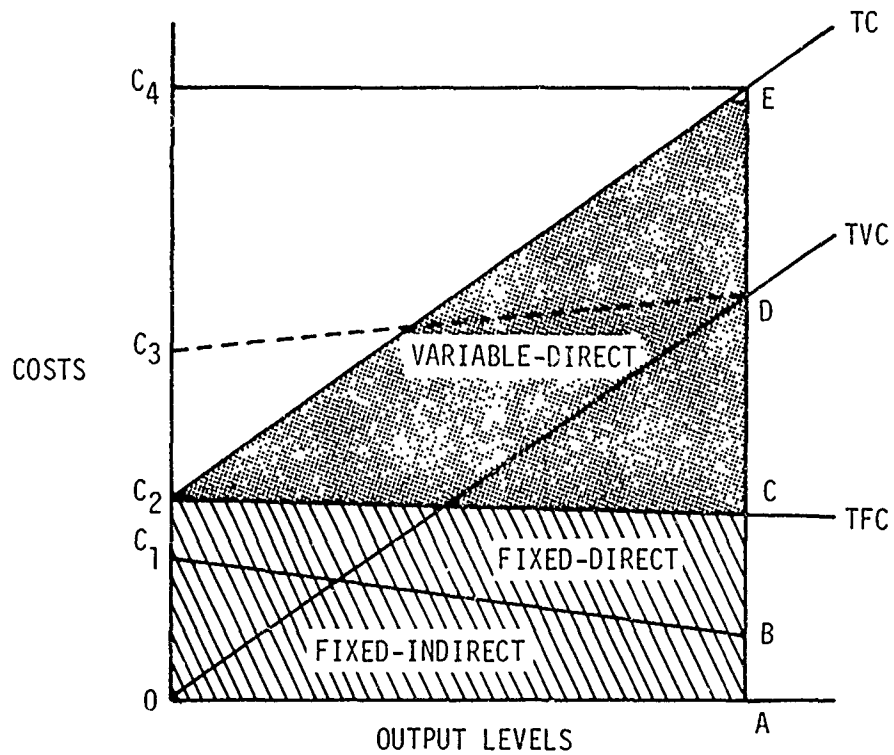
VC = VARIABLE COSTS

FC = FIXED COSTS

TC = TOTAL COSTS

$t$  = TIME

FIGURE 3. RELATIONSHIP BETWEEN TIME AND PERCENTAGE OF TOTAL COSTS WHICH ARE FIXED AND VARIABLE



TC = TOTAL COSTS  
 TVC = TOTAL VARIABLE COSTS  
 TFC = TOTAL FIXED COSTS  
 A = OUTPUT LEVEL  
 C = COST

FIGURE 4. FIXED-VARIABLE COSTS AS RELATED TO DIRECT-INDIRECT COSTS FOR THE SHORT-RUN

APPENDIX A

SELECTED DEFINITIONS OF DIRECT-INDIRECT COSTS

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The following were selected as representative of the diversity which exists in definitions. The source of each definition is listed in the references.

### DIRECT COSTS

"Those costs obviously traceable to a unit of output or a segment of business operations" (Ref. 3).

"Direct costs are those that are easily identifiable to a particular ship or aircraft" (Ref. 4).

"Any cost which is identified specifically with a particular final cost objective or goal. Varies with level of operation" (Ref. 5).

"All costs, both labor and material, that are charged to an individual course of instruction. These costs are not applicable to any other course or level of costs" (Ref. 6).

"Direct training cost - Those costs directly identifiable to a school or course; i.e., instructor salaries, texts, references, material and supplies, training aids, devices and equipment. Also includes the allocation of administrative overhead cost of the training activity" (Ref. 7).

"Direct support cost - The cost of services provided by the host activity; i.e., security, disbursing, logistic services, public works services, ADP, utilities, fire protection, transportation, personnel services, aircraft intermediate maintenance, maintenance of real property, and the cost of major repair projects" (Ref. 7).

"Direct Student Support: Manpower whose numbers are sensitive to relatively small changes (e.g., up to 15 percent) in total workload" (Ref. 8).

"Manpower resources assigned to a training activity as a result of established staffing standards/procedures, driven by official OPNAV requirements (sensitive to relatively small changes in training workload) and directly engaged in the fulfillment of the primary mission of the training activity" (Ref. 9).

### INDIRECT COSTS

"Those costs not obviously traceable to a unit of output or to a segment of business operations" (Ref. 3).

"Any cost, incurred for joint objectives, and therefore not usually identified with a single final cost objective. Includes overhead and

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other fixed costs and categories of resources other than direct costs required to add up all segments of total cost. For example, the cost of bookkeeping is often not identified with a single type of output" (Ref. 4).

Indirect support includes regional hospital, family housing, and carrier operations (Ref. 10).

"Indirect support costs; i.e., regional hospital cost, family housing cost, aircraft carrier operations" (Ref. 6).

"Indirect Student Support, including Command: Manpower whose numbers are insensitive to relatively small changes (e.g., up to 15 percent) in total workload, overhead manpower. Generally does not contribute to incremental cost of training per graduate or per unit of load" (Ref. 7).

"Manpower resources whose numbers are insensitive to relatively small changes in training workload (0%-15%). Executive/administrative/supply departments and such personnel associated with base operations type functions" (Ref. 8).

"Indirect costs are those incurred for the Navy as a whole, but not readily identifiable to individual ships or aircraft" (Ref. 9).

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